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MENSURATION IN THE PHYSICAL DIAGNOSIS OF PULMONARY PHTHISIS.

By GEORGE A. EVANS, M.D.

Read before Medical Society of the County of Kings, June 20, 1893.

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The following statements may be found in a leading work on Physical Diagnosis:[1] "A most abundant formation of miliary tubercle is often found in lungs which during life gave no physical signs of disease. When physical signs are present they differ in no way from those of extensive bronchitis. The diagnosis rests almost entirely upon the general symptoms and the history of the case."

The diagnostic value of these "general symptoms and history of the case" may be questioned when we read in another work,[2] of equal merit, on this subject, that: "The acute variety of this affection has been repeatedly mistaken for typhoid fever." Again we are told in the work first quoted, that "we seldom employ mensuration in physical examinations of the lungs unless great accuracy is required, as in the record of cases."

These statements are, no doubt, entirely compatible with one another; nevertheless, it seems to the writer that if the general symptoms and history of a case of rapid pulmonary tuberculosis are so difficult to differentiate from those of a case of typhoid fever, and bearing in mind the inability of inspection, palpation, percussion and auscultation, individually or combined, always to

[1] "Physical Diagnosis." By A. L. Loomis, M.D.

[2] "Auscultation and Percussion." By Austin Flint, M.D.

guide us to a correct conclusion, then mensuration may, with fair opportunity and convenient appliances, serve us to some purpose. At all events, the great accuracy in physical examinations of the lungs to which we are told mensuration so greatly contributes, is in this affection, as well as in others, positively required.

Mensuration should comprehend not only the various dimensions of the thorax, its conformation, movements and vital capacity of the lungs, but it should also include those dimensions of the body which by virtue of bulk and size measurably determine the amplitude and modify the physiological action of the organs of respiration, namely, height and weight. In addition to these it should also take cognizance of the various phenomena of health and disease, admitting of numerical expression, which may in any way relate to the respiratory organs, namely, pulse, temperature, etc.

Numerous instruments have been devised to determine the various measurements of the chest, its shape, movements, vital capacity of the lungs, etc. The most useful of these are the cyrtometer, the stethometer and the spirometer. Calipers of various patterns, the stethograph, invented by Sanderson,[1] to record the movements of the chest on paper; the pneumatometer of Waldenburg,[2] which consists of a manometer adapted to register the tension of the respiratory air currents, are instruments of so little practical utility that they merit only passing mention.

The cyrtometer, originally introduced by Woilles,[3] consists of two halves of a jointed whalebone measure, connected by a hinge, which can be accurately adapted to the shape of the chest so that after removal the various curves on the two sides may be traced on paper. The cyrtometer now commonly in use consists of two ribbons of soft metal, generally aluminum or lead, connected by a hinge of rubber tubing. The hinge is applied over the spinous process at the level desired, and the ribbons are moulded around the chest until their ends cross at the median line in front. The instrument is carefully removed and the outline of its inner border is traced on a sheet of paper, the points corresponding to the sternum and the spine are marked, and on a line drawn from one to the other, the paper is folded so that both leaves may be pin-punctured on the outline representing the nor-

[1] "Hand-book to the Physiological Laboratory." Sanderson.

[2] "Die Pneumatische Behandlung der Respirations und Circulations-Krankheiten", Waldenburg, 1880.

[3] "Dictionary of Medicine." Quain.

mal side of the chest to make more apparent any disparity that may exist between the two sides.

Flint's cyrtometer, a description of which will also answer for Wood's, consists of a compass with short arms holding ribbons of aluminum or lead long enough to encircle the chest. An indicator is set at the desired point by a thumb-screw; the ribbons are moulded around the chest in the manner previously described; the thumb-screw is then loosened and the instrument removed. After removal, the arms of the compass and the indicator are adjusted to the same position as when applied, fastened, placed on a sheet of paper, and a tracing of the ribbons made. With a little practice, a thick piece of malleable copper wire may be made to serve as well as either of the ribbon cyrtometers described; in any case, however, they are liable to err.

Many attempts have been made to devise an instrument that would give a more correct outline of the thorax than can be secured by means of the cyrtometers described; one of these resulted in the invention of the "conformator." This device consists of a straight piece of wood or metal from ten to fifteen inches long, perforated through its transverse axis by a large number of very small canals, through which rods are pushed so that their ends rest at a right angle to, and against the surface of which an outline tracing is desired.

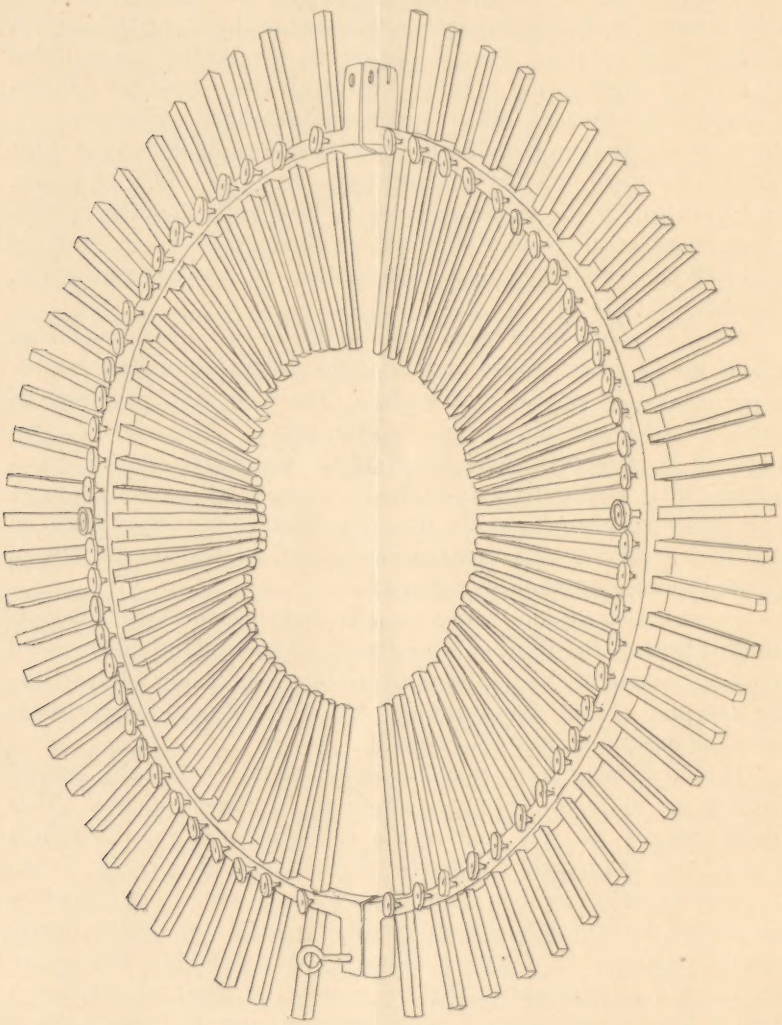
About a year ago the writer endeavored to secure correct outline tracings of the thorax by means of an instrument constructed on the principle of the pantograph; finding this to be impracticable, the plan of the "conformator" was adopted, and the cyrtometer to be described was elaborated.[1]

The instrument consists of brass bar-metal (5-8 inch), curved to form an elliptical frame, twenty-one by fifteen inches. This frame hinges at one and opens at the other of the two points which limit its greatest diameter. At the point of opening a pin operates to make the instrument firm when closed. The frame is perforated, horizontally, by sixty-two grooves or channels, thirty-one on each side, through which brass rods (3-16 inch) slide, converging toward the center; these rods may be fixed at any point desired by small set screws, which operate from the upper surface of the frame.

The instrument operates as follows: The rods are pushed through the grooves of the frame toward the outside until their centric ends are all on a line with its inner margin; the frame is then opened and the patient placed within so that the antero-pos-

[1] Made by F. Haslam & Co., Brooklyn, N. Y.

terior diameter of the chest corresponds to the short diameter of the ellipse; the frame is then closed, and when the desired level has been attained, the rods are pushed snugly against the chest



CYRTOMETER.

and fixed in that position by the set-screws, care being taken that the sixteenth rod from either end in front is opposite the median line of the sternum, while at the back the corresponding rod is opposite the spinous process.

The frame is now opened and removed, then re-closed and placed on a sheet of paper and a tracing made.

It must be confessed that this instrument is somewhat bulky as well as heavy, and perhaps more difficult to manipulate than any of the others referred to; nevertheless it is much more exact in its results, and may be quite conveniently used if placed on an adjustable combination of table and chair, such as the writer has devised for the purpose.

The stethometer is an instrument for measuring the movements of the chest or of its parts during respiration. Various forms of this instrument have been invented by Quain, Gibson, Leared, Carroll and others. They essentially consist of graduated dials or slides moved by a mechanism connected with cords or tapes passing round one or both sides of the chest.

Expansion on one or both sides of the chest may also be conveniently noted by means of Hare's double tapes. This arrangement is made by joining two ordinary measuring tapes so that the beginning of each may be in the centre. By putting this point of junction upon the spine the ends can be passed around the chest at the required level, and the expansion of each side seen at a glance.

The circumference of one or both sides of the chest may also be accurately determined by this simple device.

The spirometer is an instrument for measuring the extreme breathing capacity of the lungs. This has been called the "vital capacity," signifying "the volume of air which can be displaced by living movements."

This instrument, which was devised by Hutchinson,[1] consists of a mouth-piece and tube communicating with a vessel containing water (gasometer), out of which a receiver of registered and graduated capacity is raised by the patient's expiratory volume of air. Hutchinson's experiments with this instrument on 4,800 male subjects with regard to the modifications of the vital capacity, demonstrated that it bears a definite relation to "height, weight, age and disease."

"Height.—There is an increase of 8 cubic inches in vital capacity for every inch in height between 5 feet and 6 feet. Thus the vital capacity of a healthy person at 5 feet to 5 feet 1 inch being 174 cubic inches; at 5 feet 4 inches it would be 174x32, 206 cubic inches; at 5 feet 8 inches, 238 cubic inches, etc.

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[1] Medico-Chirurgical Trans., London, 1846.

"Weight.—Excess in body weight is associated with diminished capacity in the proportion of 1 cubic inch per 1 pound excess.

"Age.—From thirty to sixty years the vital capacity decreases nearly 1 1-2 cubic inch per year.

"Disease.—The vital capacity is diminished in lung-disease from ten to seventy per cent."

From other data gathered by the writer and from personal observations it has been learned that the vital capacity increases from fifteen to thirty years of age; that it is about thirty cubic inches relatively less in females than in males; that there is apparently no direct relation between the circumference of the chest and the vital capacity of the lungs, and that while, as a rule, all thoracic and abdominal disease, characterized by morbid growths, collections of fluid or inflammatory action, limits the breathing capacity, old pleuritic adhesions do not materially affect it.

With regard to the significance of variations in the vital capacity in pulmonary phthisis, Hutchinson reached the following conclusions:[1] "It has been found that ten cubic inches below the due quantity, *i. e.*, 220 instead of 230 inches, need not excite alarm; but there is a point of deficiency in the breathing volume at which it is difficult to say whether it is merely one of those physiological differences dependent on a certain irregularity in all observations or deficiency indicative of disease.

"A deficiency of sixteen per cent. is suspicious. A man below fifty-five years of age breathing 193 cubic inches instead of 230 cubic inches, unless he is excessively fat, is probably the subject of disease.

"In phthisis pulmonalis the deficiency may amount to ninety per cent., and yet life be maintained The vital capacity volume is likewise a measure of improvement. A phthisical patient may improve so as to gain 40 upon 220 cubic inches."

The following table,[2] showing the normal relation of weight to stature as determined by measurements of 2,648 healthy male subjects, is of so much value in this connection that it is appended. It will be observed that from 60 inches to 72 inches of stature 5.4 pounds are added for each inch. According to the English standard the average man is 68 inches in height, and the average woman is 64 inches. There is no reliable data, however, that shows a relative difference in the weight of the sexes.

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[1] Cycl. Anat. and Physiology, loc. cit.

[2] Cyclopædia Anat. and Physiology.

Inches.	Lbs.	Inches.	Lbs.
60	114.5	67	148.4
61	119.9	68	155.2
62	126.1	69	162.1
63	132.9	70	168.6
64	138.1	71	174.2
65	142.1	72	179.6
66	144.6		

Stature in connection with pulmonary phthisis has been shown to have a very important determining influence. James, in writing on this subject, says[1]: "That as tall individuals have a distinctly greater respiratory capacity than short ones, any conditions which render life sedentary must in them produce in a special degree lessening of the respiratory functional activity. Inasmuch, however, as a lessened respiratory functional activity is a fruitful cause of that defective state of nutrition which disposes to phthisis, this means in the tall a greater liability to that disease." In support of this contention James gives the following table of 237 cases of pulmonary phthisis:

Inches.	Per cent. of cases.	Inches.	Per cent. of cases.
62 (and under)	2.1	68	16.8
63	1.6	69	14.7
64	5.9	70	12.6
65	8.8	71	5.0
66	11.8	72 (and over)	6.3
67	13.9		

Age in relation to pulmonary phthisis is a subject of considerable importance. Abundant data exist to show that the disease occurs most frequently between the twenty-fifth and thirtieth years, and that during childhood and from the seventieth year to the close of life it is comparatively infrequent.

THE SHAPE OF THE THORAX.

The thorax resembles an irregular truncated conical case, with symmetrical sides, flattened from before backwards, so that its antero-posterior diameter is about one-third less than its transverse. Of its four surfaces the axillary are the most regular, and the posterior the least so.

The *anterior* aspect of the chest is slightly and regularly convex down to the inferior margin of the sixth rib.

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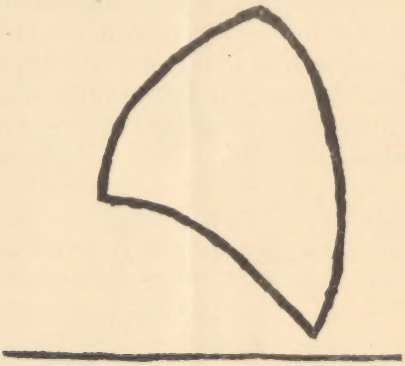
[1] "Pulmonary Phthisis."

The *lateral* walls are regularly bulging from the apex to the edges of the false ribs (base), and they are so thinly covered by soft parts that they closely correspond to the lungs.

The *posterior* surface of the chest, which is made irregular by the spine, muscles and scapulæ, gradually widens toward the base and terminates at the level of the eleventh rib.

The *lower* boundary of the thoracic cavity may be represented by a line drawn from the spinous process of the twelfth dorsal vertebra to the ensiform cartilage; on the left side this line passes a little higher than on the right.

In females the chest is somewhat more conoidal in shape, and its walls are more regular in development than in males; on casual observation, however, this would not seem to be the case.



Outline of a vertical section of a plaster cast of the cavity of the thorax.

In children the chest is more cylindrical in form than in adults, while in old age its conformation is so modified by the habits and occupations of earlier years, as well as by the law of organic mutation, that it is difficult to define a specific type as characteristic of this period of life, except in those cases in which atrophic emphysema occurs, to which reference will be made later on.

The two sides of the chest are of unequal dimensions in about five-sixths of all healthy subjects. An excess of about half an inch frequently exists on the right side in right-handed persons, while in left-handed individuals this excess may be on the left side; it is, however, often the same as the right chest.

There is no distinguishing the sexes by the inside form of the thorax, they so perfectly resemble each other[1]. Todd[2] says: "The

[1] Cyclopædia of Anatomy and Physiology.

[2] *Ibid.*

chest of the female is only absolutely smaller, not always, however, and not relatively smaller than that of the male." My own experience, however, is at variance with this statement.

The following table of average post-mortem measurements of the thorax, giving the mean of the measurements of fourteen males and six females, is of considerable value in this connection :[1]

	Males.	Females.
Age	51 years.	40 years.
Height	66 inches.	62 inches
Weight (without clothes)	110 lbs.	94 lbs.
Weight of heart	13 ozs.	11 ozs.
Weight of right lung	[illegible] ozs.	19 ozs.
Weight of left lung	25 ozs.	17 ozs.
External circumference at nipples	32 ins.	30 ins.
Internal circumference (maximum)	32 ins.	24 ins.
Internal circumference (right half)	15 ins.	13 ins.
Internal circumference (left half)	15 ins.	13 ins.
Greatest depth of thorax, from before backwards	6.5 ins.	6 ins.
Distance between sternum and bodies of dorsal vertebræ	4 ins.	4 ins.
Projection of dorsal vertebræ into thoracic cavity	2.5 ins.	2.5 ins.
Greatest breadth of cavity of thorax	9 ins.	8 ins.
Internal superficies of costal walls of thorax	258 sq. ins.	212 sq. ins.
Superficies of diaphragm	49 sq. ins.	35 sq. ins.
Superficies of entire boundaries, costal and diaphragm	307 sq. ins.	247 sq. in.
Volume of right half of thorax	151 cu. ins.	109 cu. in.
Volume of left half of thorax	182 cu. ins.	141 cu. ins.
Volume of entire cavity	333 cu. ins.	250 cu. ins.
Depth of right lung from apex to arch of diaphragm	7 ins.	7 ins.
Depth of left lung from apex to arch of diaphragm	9 ins.	8 ins.
Depth from between apices to diaphragm	8 ins.	7 ins.
Depth from before backwards, right lung (maximum)	6 ins.	[illegible] ins.
Depth from before backwards, left lung (maximum)	6.5 ins.	5.5 ins.
Distance between center of apices of lung	2.5 ins.	2.3 ins.
Vital capacity	205 cu. ins.	187 cu. ins.

EXPANSION OF THE CHEST.

Normal respiratory movements are usually described as superior costal, inferior costal, and abdominal. In superior costal respiration the sternum and ribs rise and fall with inspiration and expiration respectively.

[1] Transactions of Medico-Chirurgical Society, London, 1846.

In inferior costal respiration, the lower ribs expand and retract laterally, while in abdominal breathing the parietes rise and fall inversely to the rise and descent of the diaphragm.

According to Sibson[1] the following numbers denote the movements of the various parts of the chest in health:

"(1). The sternum and the first *seven* ribs in tranquil breathing advance forward from .02 to .07 inch. The left *fourth, fifth* and *sixth* cartilages, and the *sixth* rib, move less than on the right side, on account of the position of the heart.

"In forced inspiration the movement forward is from *half an inch to two inches.*

"(2.) The expansion of the *eighth* and *tenth* ribs varies from .05 to .1 inch. During deep respiration it is increased, but is less than that of the first five ribs.

"(3.) The abdomen moves forward in tranquil inspiration from .25 to .3 inch. In deep inspiration the movement amounts to about *one inch.*"

In order to determine the relative power of the inspiratory muscles to those of expiration, Todd[2] made pneumatometric measurements of 1,500 men of various classes. The following table, with expressive words attached, gives the result of this investigation:

Power of Inspiratory Muscles.		Power of Expiratory Muscles.
1.5 inches	Weak	2.0 inches.
2.0 "	Ordinary	2.5 "
2.5 "	Strong	3.5 "
3.5 "	Very strong	4.5 "
4.5 "	Remarkable	5.8 "
5.5 "	Very remarkable	7.0 "
6.0 "	Extraordinary	8.5 "
7.0 "	Very extraordinary	10.0 "

Todd states: "When these powers are equal, disease exists."

In tranquil respiration, inspiration exercises very little effect on the circumference of the chest; in deep breathing, however, the enlargement may amount to four or five inches. In the healthy adult the difference between the extremes of inspiration and expiration should not be less than two and a half inches, as shown by the circular measurement of the chest at the level of the fourth rib.

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[1] Aitken's "Science and Practice of Medicine," *loc. cit.*,

[2] Cyclopædia Anat. and Physiology.

According to Hutchinson the average frequency of the respiratory movements is twenty per minute in the sitting posture. According to Quetelet the respiration movements range, in frequency, from 44 at birth to 18 at the fiftieth year.

In males, inferior costal and abdominal respiration are most pronounced.

In females, the superior costal type predominates, while in young children, abdominal breathing is most marked, irrespective of sex.

In young women the respirations are somewhat less frequent than in young men of the same age.

Hutchinson determined that the normal relation of the respiratory acts to the pulse are as one to four, *i. e.*, one respiratory act to four pulsations of the heart.

Flint states [1] that: "the various physiological conditions which have been noted as affecting the pulse have a corresponding influence on respiration." In young children, however, the relation of the respiratory acts to the pulse rate is as one to three.

In pulmonary disease the one to four relationship of the respiratory acts to the pulse rate disappears because of a disproportionate increase in the frequency of the former to the latter, while in anæmia its disarrangement is the result of lessened frequency of respiration and an accelerated pulse rate combined.

According to Walshe,[2] the circumference of the chest, taken opposite the sixth rib, ranges between 27 inches and 44 inches (average 35½ inches). Sieveking, however, estimates the average circumference above the nipples to be 38 inches.[3]

Woilles[4] states that the mean circular capacity of the chest equals about 33 inches in the healthy adult.

Page[5] places the normal chest circumference of a person 68 inches high at 38½ inches.

The so-called European standard of measurement determines the normal mean chest circumference to be one-half the individual's height; a person 68 inches high, therefore, should have a *mean* chest circumference of 34 inches.

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[1] "Physiology."

[2] "Diseases of the Lungs." (4th edition).

[3] Powell, "Diseases of the Lungs and Pleuræ," *loc. cit.*

[4] "Stokes on the Chest," *loc. cit.*

[5] "Physical Diagnosis."

The following table, compiled by Roberts, shows the progressive increase in the circumference of the chest as it occurs normally:

Age. Years.	Chest Circumference. Inches.	Annual Rate of Growth. Inches.
10	23.77	0.50
11	24.33	0.56
12	24.81	0.48
13	26.30	1.49
14	28.18	1.88
15	29.70	1.52
16	31.19	1.49
17	32.80	1.71
18	34.03	1.23
19	34.76	0.73
20	35.13	0.37
21	35.42	0.29

Temperature.—The temperature of the body in health varies through the day. It has been shown by Jürgensen, Liebermeister, Ogle and others that the temperature of a healthy person in the recumbent posture will fluctuate from 1.8° to 2.3° Fahr., in the course of twenty-four hours, reaching its lowest point between 2 A.M. and 6 A.M., and its greatest elevation between 5 P.M. and 8 P.M.

Remissions and also intermissions of febrile temperature are frequently noticed in the decline of acute affections; they are characteristic, however, of pulmonary phthisis, chronic syphilitic affections, as well as of malarial diseases.

Baümnler,[1] writing on this subject, says: "The intermittent type of pyrexia is most typically shown in malarial fevers, in which the elevation of temperature may follow a quotidian, tertian, or quartan type. The same also sometimes occurs in chronic tubercular disease of the lungs.

"Pyrexia of a remittent type may present a peculiarity which is worthy of note, as being of some diagnostic value. Whereas in the great majority of cases the daily fluctuation follows the rule of health, the exacerbation taking place in the evening, we sometimes meet with cases where this order is reversed, the rise taking place in the morning, and the remission occurring in the evening. This 'inverse type,' as Traube called it, . . . has been observed in some *rare* instances in typhoid fever, more frequently in

[1] Quain's Dictionary of Medicine, *loc. cit.*

cases of chronic lung disease; whilst in doubtful cases of inflammation of the lungs it has more significance as to the disease belonging to the class of phthisis.

"Slight deviations in the maximum daily rise of a febrile temperature occur sometimes in this way, that the height is reached in the middle of the day, or that the exacerbation takes place in the night, or that two or more considerable elevations, instead of one only, take place in the twenty four hours. Such occurrences which have been observed in typhoid fever and phthisis, can, of course, only be found out by the observations of the temperature being repeated with sufficient frequency."

In chronic diseases of the respiratory organs not of an inflammatory or tuberculous nature, as well as in chronic heart disease, the temperature is usually somewhat below normal.

In excessive hæmoptysis the temperature frequently falls as low as 97° Fahr. A daily sub-normal temperature is also characteristic of chronic pulmonary phthisis during the early morning hours.

The following statement is based on the writer's own clinical experience: a febrile temperature exists in all the stages of phthisis pulmonalis. *Its daily maximum rise occurs, as a rule, from* 1 *p.m. to* 3 *p.m. In view of this fact, a daily appearance of fever, even though slight, having its maximum rise during the afternoon, should be regarded as evidence in favor of the existence of pulmonary phthisis.*

A sudden pronounced increase of the temperature in the course of a case of chronic tuberculous phthisis, generally indicates the occurrence of a further tuberculization of hitherto healthy lung substance, or the onset of acute miliary tuberculosis.

Table showing the morning, afternoon and evening variations of temperature (Fahr.) in twenty cases of chronic pulmonary phthisis, compiled by the writer from the records of cases in private practice:

Case No.	Sex.	Age—Years.	8 to 10 A.M.	1 to 3 P.M.	5 to 8 P.M.	Stage.
1	Female	29	99.4	102.4	99.8	3
2	"	35	99.	102.	100.8	3
3	Male	25	98.8	100.6	99.2	1
4	Female	33	100.	102.	100.4	3
5	"	33	99.	99.4	99.	1
6	Male	37	99.	100.	99.2	1
7	Female	34	99.2	101.8	100.	1
8	"	26	98.4	99.2	99.2	2
9	"	38	99.4	100.6	99.6	2
10	"	34	99.	101.	99.6	2
11	Male	23	97.6	100.6	99.6	2
12	"	40	98.	100.	99.4	2
13	"	31	98.8	101.8	100.	3
14	Female	24	98.6	100.9	99.8	2
15	Male	21	99.	101.8	100.	2
16	"	23	98.6	100.	99.	1
17	"	39	98.6	99.	99.	1
18	"	25	98.8	100.	99.5	1
19	"	31	98.2	100.	98.6	1
20	"	36	100.	102.4	101.	3
Average temperature.....			98.77	100.10	99.18	1st stage.
" "			98.55	100.58	99.60	2nd stage.
" "			99.44	102 12	100.40	3d stage.
" "			98.920	100.933	99.726	All stages.

Fox says: [1] "The temperature of the first stage is most important in relation to diagnosis. . . . . These more markedly febrile cases necessarily attract attention, but it is important to remember that a very slight degree of fever, often barely reaching 100° Fahr., and sometimes scarcely exceeding 99°, may for some time precede any discoverable physical signs; and further, that such pyrexia may only occur during a short period in the post-meridianal hours. The importance of frequent observations in such cases cannot, therefore, be overrated.

[1] "Diseases of the Lungs and Pleura," by Wilson Fox.

"I append a series taken by my friend Dr. Nash, of Notting Hill, on a young lady with slight dulness under one clavicle and in the supra-spinous fossa of the opposite side, who had had hæmoptysis four months previously, and in whom there was hereditary predisposition. She had previously been pronounced after *limited*[1] thermometric observation to be free from fever:

9 A.M.	3 P.M.	9 P.M.
98.2	99.8	99.2
99	99.4	98.6
98.8	99.4	98.4
99.4	99.4	98.8
98.8	99.2	98.6"
Average Temperature 9 A.M. 98.84	3 P.M. 99.44	9 P.M. 98.72

The following table shows the normal relation of weight, vital capacity of the lungs, chest circumference and expansion to height:

Height.	Weight[2]	Vital Capacity of the Lungs.		Extreme Circumference of the Chest.		Expansion of the Chest.[7]	
Inches.	Lbs.	[3] Male. Cubic inch.	[4] Female. Cubic inch.	[5] Male. Inches.	[6] Female. Inches.	Male. Inches.	Female. Inches.
60	114.3	168	136	33.00	31.00	2.50	2.00
61	119.9	174	144	34.06	32.06	2.71	2.21
62	126.1	182	152	35.13	33.13	2.92	2.42
63	132.9	190	160	35.70	33.70	3.13	2.63
64	138.1	198	168	36.26	34.56	3.34	2.84
65	142.1	206	176	36.83	34.83	3.55	3.05
66	144.6	214	184	37.50	35.50	3.76	3.26
67	148.4	222	192	38.16	36.16	3.97	3.47
68	155.2	230	200	38.53	36.53	4.18	3.68
69	162.1	238	208	39.10	37.10	4.39	3.89
70	168.6	246	216	39.66	37.66	4.60	4.10
71	174.2	254	224	40.23	38.23	4.81	4.31
72	179.6	262	232	40.80	38.80	5.02	4.52

[1] Italics are mine.—G. A. E.
[2] Cyclopædia of Anatomy and Physiology.
[3] Medico-Chirurgical Soc. Transactions, 1846.
[4] Author's computation.
[5] Allen, Med. Exam. for Life Insurance, N. Y., 1872.
[6] Author's computation.
[7] Author's computation.

DEFORMITIES OF THE CHEST.

Loomis[1] asserts that a perfectly symmetrical chest is rarely met with even among the healthy. He reports that out of 1,500 persons examined by him, he found only one well-proportioned, symmetrical chest in seven; these deviations, he says, are due, in most instances, to slight curvatures of the spine, either acquired or the result of former diseases of the vertebræ. The writer has *never been able to find a perfectly normal chest absolutely symmetrical*, although extensive cyrtometric investigations have been made with that object in view. The best proportioned chests have, as a rule, shown one side to be larger than the other at the level of the fourth rib. Post-mortem investigations show the internal vertical measurement of the left chest to be fully one inch more than on the right side.

Fox,[2] writing on this subject, cites a case reported by Bayle, where a sculptor remarked on the perfect symmetry of the chest of a man who had died of acute tuberculosis.

Out of 197 phthisical subjects examined by Fox with respect to the size of the chest (129 males and 68 females), he found it narrow in 93, and of good or average shape in 104.

The phthisical chest of Engle is described[3] as existing in three forms: the long cylindrical, the paralytic barrel-shaped and the paralytic conical. These forms of phthisical chest, however, Engle says, *Are the result and not the cause of tuberculosis.*[4]

According to Espinay Capo, of Madrid:[5] "When the circumference of the thorax at the level of the axilla is less than 27 inches, that at the xiphoid cartilage not more than 31 inches, and the distance between the two but 7 inches, the probability of pulmonary tuberculosis is very great."

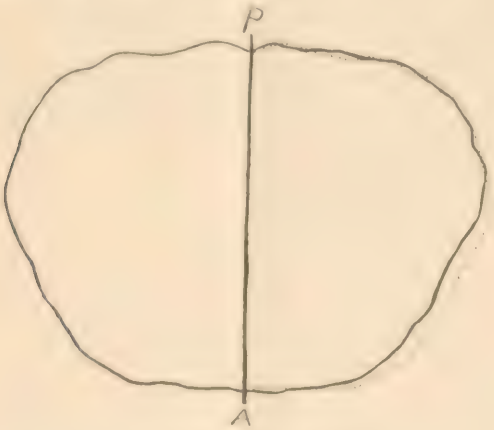
Deviations from the form or size of the normal chest may be either general or in part; these deviations are due either to abnormal modifications of the thoracic walls, or to disease of their containing organs.[6]

The chest may be abnormally small, i.e., diminished in all its diameters without being otherwise deformed; in such a case the lungs are likewise too small, either the result of congenital defect, or due to the atrophic emphysema of old age; in the latter event,

[1] "Physical Diagnosis."
[2] "Diseases of the Lungs and Pleura."
[3] "Diseases of the Lungs and Pleura." Fox, *loc. cit.*
[4] "Italics are mine.—G. A. E.
[5] Trans. of the Congress for the Study of Tuberculosis, Paris, July 25 to 31, 1888.
[6] We are indebted to Sir William Jenner for much of our knowledge on this subject. *Vide* Quain's Dictionary of Medicine.

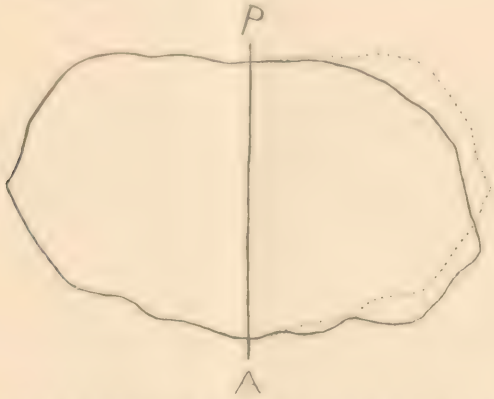
the supra-clavicular space will be depressed. In abnormally small chests the ribs assume a more oblique direction.

In abnormal general enlargement of the thorax, most frequently due to hypertrophic emphysema, the ribs assume a more horizontal direction, the lower intercostal spaces are widened, the shoulders are raised and the chest is enlarged in all its directions without being otherwise deformed.



Cyrtometer curve of an emphysematous thorax in a male, æt. 74 years. The dotted line shows a slight difference in the size of the right and left sides of the thorax. A—Sternum. P—Spine.

Other deformities of the chest which may be classed as irregular are characterized by a loss of symmetry of its walls, an increase or diminution of one or more of its various diameters and local flattening or bulging.

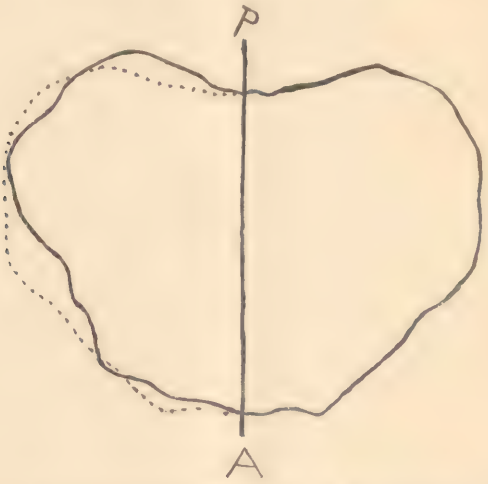


Cyrtometer curve of a twisted left chest, in a male, æt. 31 years, the result of a fall, taken ten years after recovery. The dotted line shows the difference in the shape of the two sides of the thorax. A—Sternum. P—Spine.

Flattening of the chest from before backwards, with a proportionate increase in its transverse diameter, is usually associated with small lungs; it is a form of chest common to tuberculous subjects. Interference with the free admission of air to the lungs, from one cause or another, and undue flexibility of the ribs are the most frequent causes of this deformity.

In the pigeon-breast of rickets the antero-posterior diameter of the chest is markedly increased; the costal cartilages are very firm, while the ribs are abnormally soft and give way under the combined force of atmospheric tension and inspiratory effort, so that the softest part of the ribs, which is near their sternal ends, is pressed inward, while the sternum is pushed forward by the unyielding costal cartilages.

Depression of a supra-clavicular fossa is the result of atrophic emphysema or of apical consolidation of lung.



Cyrtometer curve of the thorax (at the level of the fourth rib) in tubercular infiltration of the upper and middle lobes of the right lung, in a female, æt. 26 years. The dotted line shows the difference in the size of the right and left sides of the thorax. A—Sternum. P—Spine.

Uniform dilatation of one side of the chest is due to the presence of fluid or air, or of both, in the pleural cavity, and to encephaloid cancer of the lung.

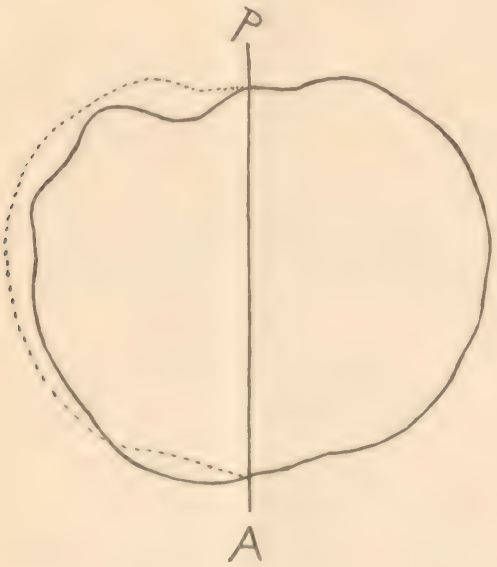
Uniform contraction of one side of the chest results from cirrhosis of the lung, chronic pulmonary phthisis, infiltrating cancer of the lung, chronic interstitial pneumonia, and condensation of lung due to long continued pressure by fluid in the pleural cavity.

Localized dilatation or bulging is due to prominent or knuckled costal cartilages, localized emphysema, fluid in the pleural cavity,

aneurism of the arch of the aorta, or of the innominate artery, enlargement of the heart, tumors, abcess, hydatids, etc.

Localized retractions of the chest are due to chronic inflammatory or congestive conditions of the apex of the lung, excavation of lung substance, chronic thickening of the pleura resulting in contraction followed by retraction of the chest wall, localized cancerous infiltration of lung substance, etc.

Deformity of the thorax is very frequently due to lateral curvature of the spine, as Loomis has stated. In angular curvature of the spine the antero-posterior diameter of the chest is increased in proportion to the amount of destruction of the bodies of the vertebræ.

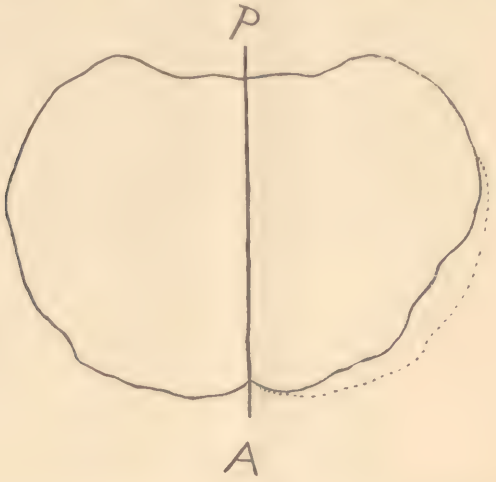


Cyrtometer curve in retraction of the right chest (at the level of the fourth rib) in interstitial pneumonia, in a female, æt. 26 years. The dotted line shows the difference in the size of the two sides of the thorax. A—Sternum. P—Spine.

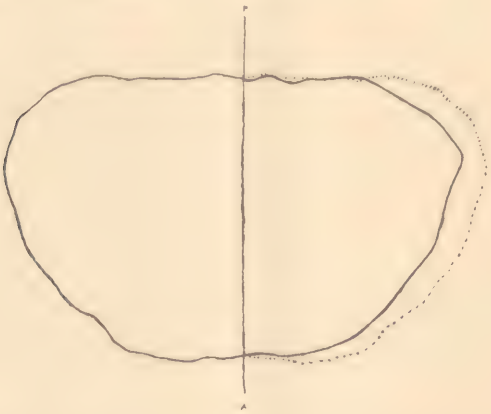
Undue softness of the costal cartilages leads to extreme depression of the lower part of the sternum.

Depression of the lower part of the sternum with a lessened antero-posterior diameter of the chest frequently occurs in children whose costal cartilages are normally quite soft, as a result of complete or partial stenosis of some of the upper air passages; this is due in many instances to the presence of morbid growths in the

vault of the pharynx or nasal passages.[1] Interference with the normal passage of air to the lungs, from any cause, leads to



Cyrtometer curve in retraction of the left thorax (at the level of the nipples) ten years after an attack of pleurisy, in a boy æt. 16 years. The dotted line shows the difference in the size and shape of the thorax on the two sides. A—Sternum. P—Spine.

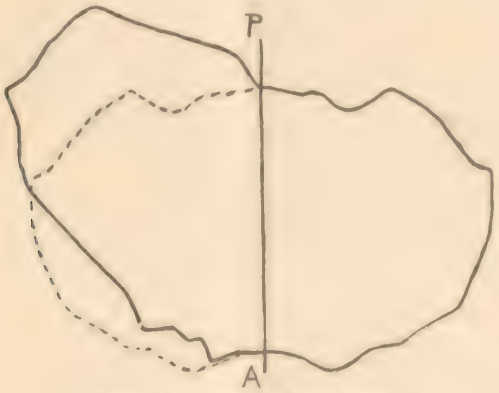


Cyrtometer curve in retraction of left thorax (at the level of the nipples) eight months after an attack of pleurisy, in a male, æt. 37 years.

[1] This deformity was graphically illustrated by a number of photographs which were presented with a paper: "Lymphoid Growths in the Vault of the Pharynx," by Dr. T. R. French, before the Medical Society of the County of Kings, April 18, 1893, and published in the BROOKLYN MEDICAL JOURNAL for June, 1893.

exaggerated action on the part of the respiratory muscles and, under such circumstances, much of their force is exerted on the walls of the chest Moderate flattening of the upper part of the thorax may be due to what is called physiological atelectasis of the lung, a condition generally associated with anæmia and occurring in young adults of sedentary habits.

Congenital deformities of the thorax are few in number, the most common of these are cleft sternum and defective formation of one or more ribs. Deformity of the chest may also be due to external pressure, caused by habitual malposition of the body, as in the depressed lower sternum of shoemakers, etc.



Lateral Curvature of the Spine.

The object of this paper is to bring into practical relationship the various data of mensuration, as enumerated, with a view to the establishment of a method of procedure that may make the diagnosis of pulmonary phthisis, in its early stage, more certain. The following table, compiled from a record of cases taken from the writer's private practice, is offered to determine to what extent it may be possible to formulate such a method. Although a consideration of the various measurements and conformation of the thorax is important in this connection, much of it may, nevertheless, be dispensed with, and with a view to greater simplicity, this has been done.

Case. No.	Height. Inches.	Weight. Lbs.	Extreme Circumference of the Chest. Inches.	Expansion of the Chest. Inches.	Vital Capacity of Lungs. Male. Cubic	Vital Capacity of Lungs. Female. inches.	Respiration per minute. No.	Pulse per minute. No.	Temperature. 8 to 10 A.M.	Temperature. 1 to 3 P.M.	Temperature. 6 to 8 P.M.	Age. Years.	Disease.
1	67.	108.5	2[illegible].5	2.	90	[illegible]	35	132	101	104	102.4	20	Chronic Pulmonary Phthisis, third stage.
2	61.	82	27.	2.	.....	98	18	90	98.4	99.2	99.2	26	" " "
3	61.5	99.5	27.5	2.	.....	60	20	120	99.4	100.6	99.6	38	" " "
4	66.	121.	28.5	3.	.....	80	24	112	99	101	99.8	34	" " "
5	60.5	105.5	29.5	2.	.....	75	24	78	98.4	98.6	98.6	34	" " " in arrest.
6	68.	155.	34.5	3.	160	.....	20	78	98.4	99.4	99	31	" " "
7	64.	108.	32.25	2.5	.....	140	19	90	99.4	101.8	100	34	" " "
8	64.	119.	30.	2.5	.....	110	18	90	98.6	99.6	99.4	26	" " "
9	63.	145.5	34.	2.	.....	125	27	84	99	100	99.4	33	" " "
10	67.25	127.	31.75	2.25	215	.....	19	76	99	100	99	37	" " "
11	66.50	133.	32.5	3.	135	.....	24	84	98.8	100	99.5	25	" " "
12	64.50	111.5	30.25	1.5	125	.....	24	87	96.1	98.1	97.5	62	" " " vegetarian.
13	67.	127.	31.	4.	.....	140	19	76	Normal	Normal	Normal	34	Bronchiectasis.
14	67.	105.	31.	Not taken	Not taken	... ...	35	120	101	101.6	102.5	35	Chronic Pleuritis { Before the evacuation of fluid.
15	65.	108.	29.5	3.	.....	115	15	82	99	{ Not taken	{ Not taken	16	Anæmia (school girl).
16	66.	124.	28.5	3.	.....	160	19	76	99.2	99.6	99.8	31	Pertussis.
17	63.	109.	27.5	1.	.....	40	35	140	99	100.5	101	34	Grave's Disease.
18	66.	116.5	32.5	1.	90	.....	24	87	98	98.4	98.4	74	Hypertrophic Emphysema { Chronic Bronchitis and Asthma.
19	63.25	128.	32.75	2.50	.....	158	19	76	Normal	Normal	Normal	57	In health (female).
20	69.75	166.	37.18	4.75	160	.....	18	72	Normal	Normal	Normal	42	" " (male).

It will be observed that variations from the normal standard occur in nearly all the columns of the cases reported as being affected with pulmonary phthisis.

In the weight column, Case 6 is about normal, while Case 9 is more than twelve pounds in excess; Case 6, however, is deficient 4 inches in the chest circumference, and 1.18 inch in expansion, while Case 9 has a chest circumference of .30 inch in excess of the normal, although in the expansion there is a deficiency of .63 inch.

In the vital capacity column, Case 6, is deficient over 30 per cent. and Case 9 over 20 per cent.

The normal one to four relation of the respiratory acts to the pulse rate practically obtains in Case 6, but in Case 9 a considerable disparity occurs. The existing relation of 27 to 84 is clearly indicative of respiratory embarrassment.

Up to this point, in our analysis of these two cases, it must be admitted we have little substantial evidence indicative of pulmonary phthisis, but when we turn our attention to the temperature columns and find the temperature of Case 6 to be 98.4, 99.4 and 99, and of Case 9 to be 99, 100 and 99.4, morning, afternoon and evening respectively, we are forced to the conclusion that pulmonary phthisis exists, provided, of course, we believe the data in the foregoing part of this paper to be correct.

Case 5 represents a patient affected with chronic pulmonary phthisis, who was kindly referred to me by Dr. John Cooper, of this city. It is a case of long standing, and the disease is now in a condition of arrest; the temperature and pulse are both normal, the expansion of the chest is only .1 inch deficient, the vital capacity, however, is 40.6 per cent. below the normal, while the respiratory acts are 24 to the minute, instead of 19 to compensate for the deficiency. This case is cited to show that although we have a normal temperature throughout the day, it is, nevertheless, possible to determine the existence of consolidated lung by mensuration alone. The absence of pyrexia, the rapid breathing and deficient vital capacity noted would, it is true, answer just as well for a case of chronic bronchitis with peri-bronchial thickening, or for hypertrophic emphysema, as for example Case 18, as well as for several other conditions; but when we take under consideration the fact that this patient's power of chest expansion is normal while the circumference of the thorax is over two inches less than normal, our diagnosis of pulmonary phthisis in arrest appears warrantable.

Case 12, which represents a vegetarian affected with chronic

pulmonary phthisis, suggests a probable ætiological relation between diet and the occurrence of the disease. The temperature in this case is notable as being subnormal even at its daily maximum of intensity. Cases 19 and 20 represent about the average normal (female and male respectively) individuals.

They, as well as cases representing several diseased conditions other than that of pulmonary phthisis, are submitted to facilitate comparative consideration.

Fever is a symptom of phthisis in all its stages, and reaching the daily maximum of its intensity between one and three o'clock P. M., is its characteristic feature—a feature, to which very little attention has been paid in the past, of such value that by its unaided means we may be able frequently to differentiate phthisis from malarial and typhoid fevers, practically the only other febrile conditions which are occasionally characterized by an afternoon maximum of pyrexia.

In conclusion, I would recommend the more extensive employment of the scale with measuring rod, the tailor's tape, the spirometer and thermometer in the investigations of all chronic chest affections. The thermometer not once a day—but provide the patient with an instrument, direct him to take his temperature about 9 A.M., 2 P.M. and 7 P.M. daily, and keep a record for inspection.

Cases of pulmonary phthisis are difficult to diagnose by physical exploration of the chest, not only in the incipient stage, but frequently, even after softening has begun, those of us who see many cases of this disease, gradually acquire the habit of being cautious in our examinations, for we doubtless appreciate the fact that the patient's neighbors are usually able to diagnose the affection when the third stage has been reached.

DISCUSSION.

DR. G. R. BUTLER:—Mr. President, Ladies and Gentlemen: The only real criticism I have to make on Dr. Evans' paper, and it is a criticism which has been made on his papers before, is that he makes them so thorough and complete that there is very little left for those to say who have been asked to discuss them, but there are some points which may be of interest.

First, in reference to the apparatus which he has devised. There is no question in my mind but that it is by far the most accurate and scientific instrument for obtaining absolutely correct outlines and contours of the chest that has yet been devised. It is an interesting fact to know that after Dr. Evans planned this instrument, a

similar one, only less complete and meritorious in its mechanical construction, was invented by a German physician and is now in use in New York by some men who treat deformities of the chest and spine. There is no doubt at all that this instrument of Dr. Evans' is the most accurate one of the kind, going far ahead of the ordinary lead ribbon. I have taken many tracings by means of the calipers and the lead ribbon. While they are fairly accurate, they cannot approach the accuracy of the tracings by this instrument in the recognition of thoracic deformities.

If these deformities are marked, I think any one accustomed to observing the healthy chest will be able to notice the deviations from the normal, if they make the examination in a good light, almost as well as with the tracing; in other words, the tracing would confirm the observation of the eye. For the purpose of record and absolute accuracy the instrument Dr. Evans has devised is extremely desirable.

The great value of Dr. Evans' paper, it seems to me, is his bringing together the various items, some more important than others, pointing toward disease in the chest, at the time when the physical signs, as shown by auscultation and percussion, may not be sufficiently marked to be of any value in making a certain diagnosis. From this standpoint, the combination of a number of the separate items, such as is illustrated in the Doctor's simple but complete table, is extremely valuable, and its value is increased by the fact that it is at that time that therapeutic measures can be adopted with the greatest chance of success. Well established phthisis pulmonalis, as we all know, is a very hopeless disease in well marked cases. The time to attack it is at its earliest onset, and in the majority of cases its progress can be stopped. I say that advisedly.

The point which the Doctor made in regard to the afternoon rise of temperature being most marked is, so far as my own experience has gone, perfectly correct.

The main value of the paper being that which I have mentioned, the prevention of phthisis, I venture to ask, with Dr. Evans' permission, to submit one point in the treatment. We all realize there are many factors in the treatment of phthisis. Medicine, general hygiene, air, climate, diet, habits of life and exercise, all come into play, depending on the case and its character. There is one item in the treatment which I have found extremely useful in the earliest stages, that is where there is deficient vital capacity and where the symptoms are such as to lead to the pretty certain conviction that phthisis is beginning—namely, so-called pulmonary

gymnastics, conducted by an operator systematically every day. I have no doubt many of us have attempted to demonstrate exercises to our patients, but the limits of time and expense are such that it is practically impossible for the physician to personally direct them. If they are left entirely to the patient they will either be forgotten, overdone, or not done sufficiently well. I have been fortunate enough to find one or two operators in this city who are able to give pulmonary gymnastics and supervise them with intelligence and skill, and I have, therefore, asked a lady who has made a specialty of that work, and whose work I have seen, to come here and demonstrate some of them. I might say in passing just what I have no doubt Miss Marsh would wish me to say, that in the carrying out of this sort of treatment the co-operation of the patient is absolutely necessary, that is one item; the second item is that the dress should be hygienic; the third, that the work should be regular daily work with simple exercises to be done at home. To quote from a brief paper written by Miss Marsh at my request:

"The diet is usually attended to by the physician. An examination of the patient is made, her habitual postures carefully noted, tracings and measurements taken, the capacity of the lungs is tested by means of the spirometer, and the muscular strength by various exercises; the frequency of the pulse and respiration is noted at the same time. A prescription suitable to the case is then made out and followed till change is required, when work of increasing difficulty is given as the patient regains strength. Examinations are made from time to time and changes in measurement and contour recorded."

I would mention one case which Miss Marsh treated for me. The notes are written from her standpoint. From my standpoint it was a case of incipient phthisis:

"Lady, twenty-two years. Disposition to phthisis caused by successive attacks of influenza; no hereditary taint. Symptoms: Fever, night sweats, breathlessness, headache, sharp pain under left scapula and left side of thorax, the upper side of which showed decided depression: loss of appetite, fitful and unrestful sleep, circulation sluggish, lung capacity bad.

I substituted hygienic dress for that worn, which was heavy and compressed the thorax considerably. Gave daily prescription of movements followed by massage; light work taken at home. At the end of one month tracings showed depression on left of thorax was nearly obliterated; measurements, that all diameters had increased; pain had ceased except at rare intervals; sleep was nor-

mal, and the appetite, if anything, above the normal. In lung capacity the average gain was fifty cubic inches. I have seen the patient twice since she left and find that the gain seems to be permanent."

Miss Marsh, having one of her pupils present, proceeded to demonstrate the movements, as follows:

Miss Marsh:—The movements which I will describe are for a patient of average muscular strength. I shall give this patient a stronger prescription than an ordinary patient, because I want to show some of the good movements. She has no actual disease.

The first movement will be a respiratory movement, which is passive on the part of the patient. The operator's hands are placed in the axilla, the patient leaning slightly back, and are then raised and drawn up and back, the patient at the same time inhaling, then down slowly into the sides while the patient exhales. This is given, perhaps, a dozen times.

Of course, in all these exercises it is absolutely necessary that the air breathed should be pure and that there is no obstruction from the clothing. The first thing to do is to get the patient into a good position. You will probably find the head drooping forward and the arms downward and forward, and the simplest way to get a good position is to get the head in position, and then naturally the chest comes up and the shoulders are thrown back and the exercises are better. They are of no use unless the patient is in good position at the beginning.

In all these exercises it is necessary that the breathing should be slow and steady, but in no case must the breath be held.

The next is called an active resistive motion. In this the patient has to overcome the force exercised by the operator. The patient's hands are placed back of the head with the elbows well to the side and then bends forward. The operator's hands are then placed on the lumbar portion of the spine and at the word the patient rises against this pressure, straightening out the dorsal curve and throwing the ribs forward.

The next is what is known as a derivative movement for the lower extremities, for bringing the blood to the lower part of of the body. The operator grasps the patient's foot and calf with both hands and causes the leg to describe a circular movement from the hip joint. The same motion is repeated with the other leg.

The next exercise is somewhat like the first, active on the part of the patient. It is a shoulder circling movement; a respiratory movement. In this case the movement is done by the patient, the shoulders being raised, carried back and down, while deep breath-

ings are taken. All through these exercises it is at first difficult to keep the patient from holding the breath, and that is one point we have always to keep in view

The next is an active resistive motion. The patient's arms are held up high above the head, extended to their full length, and she draws them forward against my resistance as I hold them back, and then I draw them out against her resistance, the patient, at the same time, keeping up regular breathing.

The next movement is what the Swedes call a specific to difficult breathing. The patient extends the arms at the sides, the operator steadies the hips and the patient rotates the upper trunk and the arms quickly from side to side.

Another form of this movement, which looks violent but which is not really so, is where the patient sits with the hands on the hips, leaning forward, body limp. The hands of the operator are placed under the arms and the body is quickly turned from side to side.

In this same posture, another active resisting movement is where the patient pushes up the hands against the operator's resistance and pulls down in the same way. This is especially for the pectoral muscles.

The next is also an active movement on the part of the patient. The feet are placed a little apart with the hands upon the hips. The body is then bent first forward nearly at right angles to the lower extremities, then to the right without rising, then back and then to the left, continuing the motion.

Another exercise which I always consider a good, simple breathing exercise: The patient standing where she can get good fresh air, the arms are raised extended above the head and the body is raised on the toes, at the same time filling the lungs with air; then down on the heels, letting the air out. That is always a good exercise and simple for the patient to learn.

The next exercise is with the patient's arm in the letter "Y" position above the head, resting against the sides of a door. The operator's hands are placed under the patient's arms and the patient is drawn forward, the operator standing in front of and facing the patient.

Dr. B. F. Westbrook:—It would be impossible to review the points made this evening without discussing the practice of medicine, almost, if we were to take them all up, and it is hard to pick out those most interesting to the Society. As Dr. Butler remarks, Dr. Evans makes his work so complete that it does not leave us much opportunity for discussion.

It occurred to me—to begin at the end and go toward the beginning—that the system of chest gymnastics which Dr. Butler has had illustrated for us, is of particularly great value from this point of view—and I think it is to that which the Doctor looks in prescribing it—that it forms a sort of performance, you might say; that it is something definite to go through with; something which attracts the attention of the patient and looks to be a little out of the ordinary way of doing gymnastic exercises. Anything that can be put on a basis of that kind, anything which will bring that particular treatment which you want the patient himself to carry out prominently before the mind and impress it, is always of great value, particularly in the treatment of chronic diseases. It has been with me one of the greatest difficulties in treating chronic patients, where I desire to have them exercise, to sufficiently impress upon them the importance of doing so, that the impression should remain permanent and effective enough to make them do it, and do it every day. It is rarely one finds a patient who will. I have assisted somewhat by teaching patients myself, but, as Dr. Butler says, it takes a long time and time is precious, and it is very discouraging sometimes after having taught a patient, to have him go home and never do anything further about it. It is not so much the particular movements, *i. e.*, the external and superficial appearance of the movements, as it is the intrinsic character of them that we have to look to. In the works on the Swedish gymnastics one will find two or three hundred movements, a few of which have been given here. They are all variations on a few fundamental principles of movement. The audience will probably have noticed that the main thing done here was done on the basis of artificial respiration as we use it in the resuscitation of the drowned—the elevation of the shoulders, the drawing backward of the clavicles and the scapulæ, and, with that, putting traction on the pectoralis minor or other muscles of the chest, throwing the ribs forward and outward. Quite a little attention is paid to the motions of resistance, which increase the power of the abdominal and dorsal muscles and aid greatly in expiration. A great deal of stress should be laid on exercising the muscles of the neck, as the strength of the cervical muscles is of great importance. I think, possibly, the Doctor may pay more attention to it than has appeared in the exhibition to-night. Of course, you can not exercise the pectoral without exercising the cervical muscles, but by additional exercises to strengthen the trapezius, levator scapulæ and muscles running from the side of the cervical spine down to the first and second ribs and shoulders, you gain support

and steadiness of the chest, which assists in all respiratory exercises. Have you ever observed the necks of consumptives?

In regard to deformities of the chest, we should not allow ourselves to be deceived by the deformity due to extrinsic causes. A chest may be deformed from extrinsic causes, such as curvature of the spine and traumatism, some congential deformity or muscular weakness, in a way that will resemble exactly a chest deformed as the result of some internal thoracic or even abdominal disease. Often a flat looking chest may be a large and good one. Every curvature of the spine, if it is marked, is necessarily accompanied by rotation of the vertebræ, which will necessarily throw the ribs of one side out beyond those of the other. In the lumbar region the articulations of the vertebræ being perpendicular the spine cannot bend sidewise without rotation, and to do that it twists as you see in paralytic cases, and as surgeons see in diseases of the hip joint. A curvature in the lumbar region dependent on a shortened limb or any other cause, will affect the vertebræ and you will necessarily get a little compensatory change in the arrangement of the thoracic skeleton.

These points are so interesting that it is hard to know when to stop talking about them.

I think a very important thing, certainly next to the most important which Dr. Evans makes to-night, is the taking of the temperature. He developed it so fully that I simply wanted to refer to it and emphasize it, and to make this remark: I have formerly done to a great extent what Dr. Evans speaks about, that is, I have supplied my patients with thermometers and have had them keep a record of the temperature for me. I have found frequently that the results were disastrous and have given it up. We all know how it is if we are treating a doctor. We take away his thermometer. And patients get into the same condition; they get frightened and many times it is unsafe, and really, while the physician gets some valuable points in working out the case, the worry and fright of the patient cause positive injury.

Another point is the examination of the heart in phthisical patients. There is probably no one thing that will carry a patient through, who is threatened with pulmonary disease, so safely and reliably as a good, strong heart—of all things it is necessary. I think Dr. Evans and Dr. Butler will agree with me when I say that probably the best of all the results accomplished by exercise in these cases is the strengthening of the circulatory apparatus. This idea was brought out by Ling in his development of the Swedish movement cure, and from him probably Dr. Oertel got the idea

when he advised the mountain climbing business; ideas, all of which occurred to others but were more carefully developed and insisted upon by these men.

DR. HERBERT F. WILLIAMS:—Inasmuch as I was invited to discuss this paper it would be unbecoming not to say anything, but on account of the late hour and oppressive heat it will be still more unbecoming to say much. I was entertained by Dr. Evans' paper and shall act on its suggestions.

It would be but a reiteration to speak of the salient points he makes, but by way of emphasis, I desire to refer to the great importance of making early diagnoses in all phthisical and tubercular conditions. All mechanical devices to this end may be commended. We may not be able to appreciate the importance of the ingenious instrument which has been exhibited to-night, still as years go by it may be found a great help and necessity in detecting early pulmonary abnormality.

DR. E. M. MOSHER:—The value of this instrument which Dr. Evans has presented and which shows so well the exact shape of the chest, depends, of course, upon our knowledge of the shape of the normal chest, or the variations from the normal, and the laws which govern those variations. In a paper which I read here a year ago on the "Influence of Habitual Posture on the Shape of the Body," those who were interested in it will remember I made the statement that where the two side lines of the body are unequal I had observed that the chest on the lower or short side was more active and a little larger than that on the upper or long side. Where a person had the habit of standing on one foot with the other thrown out at the side, lowering one shoulder and raising the hip on that side, the lung was more active. I had not at that time made any accurate measurements to prove this. When I learned that Dr. Evans was going to present this apparatus, I asked him to measure with me a number of these patients that we might have some facts to present upon this point We measured seven individuals and I am very glad to present here the plates made from these measurements. Of these patients, two were what I am pleased to call "right standing twists;" two were "right sitting twists," and three were "left standing twists." Of the three "left standing twists," two were ambi-dextrous—all the others were right handed. In the "right standing twist" cases we found the short right side with the right chest a little larger in all cases than the left, as the diagrams will show. In the "left standing" ambi-dextrous cases there was also the same thing in a little less degree. One patient showed a very positive

shortening of the left side with *larger right* lung. That patient was a stumbling-block until I examined the chest afterwards, and found what the diagram indicates, that she had had an old pleurisy and the lung on the left side is fastened down below the scapula. So this case may be thrown out and we may say from these cases we have proof, which is fairly positive, that anything which shortens the body line on one side will permit of greater motion of the respiratory muscles on that side, or rather will place the other side at a disadvantage. I would like to say in addition that I have measured with the tape very carefully the two sides of these cases and an additional number, and I found in every individual a difference of from one-fourth to one inch increase in favor of the lower side.

It seems to me, Mr. President, and members of the Society, it is of very great importance that we recognize this loss of respiratory movement on the upper side of the body which has been tilted by one influence or another.

DR. EVANS:—Mr. President, I do not know that I can add anything to what has already been said on this subject. My object in bringing the matter to the notice of the Society is to emphasize the necessity of more fully equipping ourselves to detect pulmonary phthisis in its early stage at a time when simple means may avail, rather than to devote our energies to searching for a cure we will never find, for the disease in its last stage.

I feel quite certain that all genuine advance in our management of phthisis must be made in this way.

In view of what Loomis and others tell us regarding the frequent failure of physical exploration of the chest to differentiate tubercular infiltration of lung substance from bronchitis, we can scarcely expect the general practitioner who is embarrassed by a lack of time, a want of frequent practice, the patient's diffidence, etc., etc., to make a correct diagnosis in every case of incipient phthisis he may see.

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